

BIOC 385/BIOC 585/NEUR 385 : FUNDAMENTALS OF CELLULAR AND
MOLECULAR NEUROSCIENCE Fall 2016

I will consider this course to be successful if we accomplish three major sets of learning goals. Specific learning objectives corresponding to these goals are outlined in each of the study guides.

Be able to answer the question, "What do we know?"

How do neurons generate and conduct signals? How do neurons communicate? How and why do neurons and their connections change? What mechanisms support our ability to perceive external and internal stimuli? What mechanisms support our ability to move? Be able to articulate answers to these questions, explain the underlying mechanisms, and extract and apply general principles governing these mechanisms.

Be able to answer the question, "How do we know what we know?"

How did the historically important experiments in neuroscience lead to our current understanding? What strategies are in use now toward furthering our knowledge of neuroscience and how are they applied? Be able to explain experimental strategies, troubleshoot or critique an experiment, interpret or predict findings, and perhaps design an experiment with which to address a question.

Leave this course with a desire to learn more, with the confidence that you can do anything that you set out to do

Achieve the satisfaction of learning by preparing in advance for each class, completing assignments and parts of assignments in a timely manner, learning from others and teaching others in group work, learning to access reliable sources, including the primary literature in neuroscience.

I very much hope that this will be your favorite course at Rice. Enjoy!



David R. Caprette
Professor in the Practice
Instructor, Fundamentals of Neuroscience

BIOC/NEUR 385 and BIOC 585 Fundamentals of Neuroscience

Syllabus details may be changed at any time at the discretion of the instructor.

NOTE TO BIOC 585 STUDENTS: Your syllabus is identical except for the assignments and grading scheme. Additional assignments and how they are weighed toward your course grade are described in the file "Bioc_585.pdf" in your Drop Box.

Meetings: MWF 10-10:50 am, location TBA

Instructor: David Caprette, caprette@rice.edu, ABL 327, x3498

Office hours: 11 AM - 1 PM Mon, Tues, Thurs. I will be happy to make separate appointments for individuals who cannot come in during office hours.

Group work: To encourage a teamwork approach to learning we will set up study groups of four to five students each, group assignments to be made by the instructor. Students within each group are encouraged to study together. In addition, each exam will include a set of group questions.

iClickers: You will need a working iClicker+ handset for the first day. The Campus Store will stock them, but please see the Resources for a pdf listing other purchase options.

Texts: The first study guide explains the rationale behind the selection of textbook materials. Most students should benefit by reviewing the relevant reading material in the recommended text before each class. The supplemental texts will be of marginal value. Page numbers are from the current (5th) editions.

- *[strongly recommended]* Purves, D (ed.), Neuroscience 5th edition, Sunderland, Mass: Sinauer Associates, inc., 2012, ISBN 978-0-87893-695-3
- *[supplemental]* Nicholls, JG (ed.) From Neuron to Brain 5th ed., Sinauer Associates, inc., 2012, ISBN 978-0-87893-609-0.
- *[supplemental]* Kandel, ER (ed.) Principles of Neural Science 5th ed., 2013

Additional resources: Resources in addition to the text include the following.

- A week before each class: Powerpoint slides w/notes and questions to consider in Resources folder/PowerPoint notes pages. Following class, notes pages will be replaced with pdfs showing the correct answers to clicker questions.
- Study guides with questions, Tests & Quizzes
- In the Resources section: Reference materials on electricity, links to video clips and journal articles
- Research paper and reading guide, one set per exam period, hard copies delivered in class

Course grade: The final course score for Bioc/Neur 385 will be a weighted average of scores on the following items. The final grade will be based on a straight percentage. We do not grade on a curve in this course. For the rationale, see the resource "01_Intro_F15.pdf."

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|------------------------------------|-----------|-----------|-----------|-----------|
| • Learning activities, 5% | | | | |
| • Homework sets, three at 10% each | A+, ≥ 97 | B+, 87-90 | C+, 77-80 | D+, 67-70 |
| • Mid-term exams, two at 20% each | A, 93-97 | B, 83-87 | C, 73-77 | D, 63-67 |
| • Final exam, 25% | A-, 90-93 | B-, 80-83 | C-, 70-73 | D-, 60-63 |
| | | | | F, ≤ 60 |

Learning activities:

- Learning activities include timely completion of the tutorials and study questions in Tests & Quizzes and participation in class, recorded from i>Clicker responses. Each item (completion of one tutorial, one set of study questions, participation in one class) counts equally toward the score.
- Each tutorial addresses a single concept related to the generation and propagation of signals by neurons, one step at a time, each step followed by a question.
- Study questions are similar to the questions you will see on a homework set or exam. They have you employ higher levels of critical thinking such as analyzing a situation, applying the principles, evaluating a statement, and/or creating something. Regardless of your background, you are likely to benefit from completing each tutorial and study question set by the due date. Your answers do not have to be correct in order to receive credit, but they should reflect a reasonable level of effort. You will receive full credit for submitting answers on time, half credit for submitting late but within the exam period, no credit for submitting after the exam period is over.
- Each student is expected to come to each class with a working i>Clicker and extra batteries. The learning activities score for a day will be based upon percent questions answered. Each class day except for the first week you earn full credit for answering all questions and 60% for answering at least 50% of them. There is no credit for answering less than 50% of them. Examples: skip class, forget the clicker, or come late and fail to submit an answer for 2 of 3 questions, no credit; arrive late and fail to answer 1 of three questions, earn 60%. It is your responsibility to bring a working i>Clicker to class. Again, your responses do not have to be correct, but they should reflect a reasonable attempt to learn the material.

Homework assignments:

- The homework sets are designed to assess your understanding of the major concepts, controversies, lines of reasoning, rationale behind the experiments, and significance of results. The questions and problems will give you the opportunity to apply to new situations the principles and strategies that you have learned from class meetings, readings, and your work on the study questions. Homework sets are intended to be both formative and summative, will be turned in, and will be graded.
- Homework is to be completed entirely on your own. You must not seek or provide help on any specific homework question. You may at any time seek or give help on study questions, specific presentation slides, textbook information, etc., then apply what you learned. Homework assignments are to be submitted as printed single-sided copies, with all text double spaced. You may leave space in which to add hand drawings and handwritten calculations. Please print your student ID (S followed by an 8 digit number) on the first page and not your name. I am not consciously biased when I grade assignments. All the same, identifying assignments with an ID number ensures that there will be no unconscious bias either.
- *Suggestions for homework questions.* For parts that require explanations, practice articulating your answers in your own words. Complete a problem or two at a time – don't wait until the last minute to complete the entire assignment. If you have trouble with a homework problem then try to take it apart. What is being asked, what information do you already have, what principles apply, what study question or questions might be relevant?
- *Feedback.* I cannot return the homework assignments or post keys, however you are encouraged to come to my office to review your graded homework.

Exams:

- Each exam will consist of two parts: a group question set (20%) and the individual exam (80%).
- *Individual exam.* This part of the exam is "closed book, closed notes" except for notes made on your copy of the research paper. The first exam will require that you bring a calculator. Both mid-term exams will be held in class.
- *Group question set.* About two weeks before each exam, each study group will receive a single set of four questions to be answered and submitted by the group. These questions are "open book, open notes," and the answers (to be submitted at the start of the exam) are expected to reflect a team effort.

- *Questions from the primary literature.* For each exam period each student will receive a paper from the primary literature along with a reading guide. Each set of group questions will include at least one question on the paper and each individual exam will include at least one question from the reading guide.
- *Preparing for exams.* Together, the study questions and homework sets will have you practice ways of thinking that will help on the exams. The exam questions will be new but will cover the same concepts and require familiar approaches to problems, so there should be no surprises. I do not test on minute details, however I will expect familiarity with terminology that I have used throughout multiple presentations and may expect you to be familiar with historically important experiments, prominent scientists, and major controversies. Prepare for each exam by reviewing the presentations, study questions/problems, and what you have learned from the related homework assignment. Meet with your study group to address any areas in which you aren't confident. Meet with the instructor to resolve any issues that remain before the day of the exam.
- *Feedback.* As with the homework assignments, I cannot return the exams or post keys, however you are encouraged to come to my office to review your graded exam. Your score will be posted in the Gradebook and your exam will be available during office hours or by appointment for you to look over. I will write notes on the exams where appropriate. I do not use "exam graders." I read through all exams once and mark tentative scores, then go back and re-check all questions to ensure consistency and fairness. Therefore there will be no need for "regrades" of exams.

Policies:

- *Exams.* I can arrange to have you take the exam at an earlier time if you will be unable to attend on the scheduled exam date due to reasons beyond your control, provided that you contact me a reasonable time in advance. I cannot reschedule an exam because you have another exam or a major assignment due in another course on the same day, nor can I give exams after the regularly scheduled time. If you miss an exam and you are unable to notify me in advance, then you must provide documentation in order to make up the credit. At my discretion I will either let you take the exam, replace the missed exam with an additional assignment (possibly a different exam) or under extraordinary circumstances I may choose to omit the missed exam from your final course score. Please let me know well in advance of the first exam if you require a special arrangement due to a documented disability.
- *Group assignments.* To encourage a teamwork approach to learning we will set up study groups of four to five students each, group assignments to be made by the instructor. Students within each group are encouraged to study together. In addition, each exam will include a set of group questions. Group members will be asked to work together on the questions and submit a single answer set for the entire group at the start of the corresponding in-class exam. Group questions will count for 20% of each exam.
- *Excused absences.* As with all of my classes, I excuse absences due to circumstances beyond your control including illness, family matters, unavoidable travel obligations, etc. I may or may not require documentation.
- *Late assignments.* If you are unable to turn in a completed homework assignment at class time on the day it is due, you may submit the assignment up to 24 hours late with a 10% deduction. Because of the need to release feedback on homework sets I cannot accept assignments that are more than a day late.
- *Students with disabilities.* Any student with a disability needing academic adjustments or accommodations should contact me (x3498) as soon as possible and also contact Disabled Student Services in the Ley Student Center.

Topics and graded assignments

This schedule lists only the topics to be covered and corresponding notes pages (posted in the PowerPoint notes pages folder in the Resources section). The notes pages are strictly intended to help you prepare for class and follow the discussion. They are no substitute for attending class. Please see the "Introduction to the study guides" (Tests & Quizzes) for a recommended approach to studying neuroscience and consult the daily study guides (in Tests & Quizzes) for recommended readings, supplemental resources, study questions, and learning objectives for each topic. This schedule may change depending on the pace at which we make it through the topics.

Monday 22 Aug – Course introduction; Biological basis of behavior (01_F16_intro.pdf).

Wednesday 24 Aug – Animal electricity (02_F16_anim_elec.pdf)

Friday 26 Aug – Testing the Bernstein hypothesis (03_F16_testing.pdf)

Monday 29 Aug – Discovering the diffusion potential (04_F16_discovering.pdf)

Wednesday 31 Aug – Ionic basis of an action potential (05_F16_ionic_basis.pdf)

Friday 2 Sep Conduction of the nerve impulse (06_F16_conduction.pdf)

Monday 5 Sep LABOR DAY – NO CLASS

Wednesday 7 Sep – Channel function (07_F16_chan_func.pdf)

Friday 9 Sep – Discovering the sodium pump (08_F16_Na_pump.pdf)

Monday 12 Sep – Studying channel structure (09_F16_chan_struct.pdf)

Wednesday 14 Sep – previous topic continued

Friday 16 Sep – A diversity of ion channels (10_F16_chan_diversity.pdf)

Monday 19 Sep – Introduction to synaptic transmission (11_F16_syntran.pdf)

Monday 19 Sep – HW set #1 due in class

Wednesday 21 Sep – Pre-synaptic mechanisms: role of calcium ions (12_F16_presynCa.pdf)

Friday 23 Sep – Quantal release and the vesicle hypothesis (13_F16_vesicle_hyp.pdf)

Monday 26 Sep – previous topic continued

Wednesday 28 Sep – previous topic continued

Friday 30 Sep – Midterm exam 1 – in class – will cover material up to and including the introduction to synaptic transmission

Monday 3 Oct – Postsynaptic membrane potentials (14_F16_postsyn.pdf)

Wednesday 5 Oct – Synaptic plasticity in *Aplysia* (15_F16_aplysia.pdf)

Friday- 7 Oct – previous topic continued

Monday & Tuesday 10-11 Oct MIDTERM RECESS (NO CLASSES)

Wednesday 12 Oct – Long term synaptic plasticity (16_F16_LTsypnplast.pdf)

Friday 14 Oct – previous topic continued

Monday 17 Oct – Somatosensory system (17_F16_somatosensory.pdf)

Wednesday 19 Oct – Proprioception (18_F16_proprioception.pdf)

Friday 21 Oct – previous topic continued

Friday 21 Oct – HW set #2 due in class

Monday 24 Oct – Detecting auditory signals (19_F16_hearing1.pdf)

Wednesday 26 Oct – previous topic continued

Friday 28 Oct – Midterm exam 2 – in class – will cover pre-synaptic mechanisms through proprioception – no material on hearing

Monday - Friday 31 Oct - 4 Nov – Encoding auditory signals (20_F16_hearing2.pdf)
Monday 7 Nov – Vestibular system (21_F16_vestibular.pdf)
Wednesday 9 Nov thru Wednesday 16 Nov – Vision (22_F16_vision.pdf, 23_F16_vision2.pdf, 24_F16_vision3.pdf)
Friday 18-Nov – Pain and temperature detection/perception (25_F16_pain.pdf)
Monday 21 Nov – Chemical senses (26_F16_chem_senses.pdf)
Wednesday 23 Nov – OPTIONAL REVIEW SESSION

***Thursday-Friday 24-26 Nov* THANKSGIVING BREAK**

Monday 28 Nov – Motor control - motor cortex (27_F16_movement1.pdf)
Wednesday 30 Nov – Motor control - basal ganglia (28_F16_movement2.pdf)
Friday 2 Dec – Motor control - cerebellum (29_F16_movement3.pdf)

Friday 4 Dec – HW set #3 due in class

Final exam TBA – hearing, vestibular system, vision, pain/temperature, chemical senses, and motor control (plus two questions on the third research paper)

Some questions on the final exam may require skills/knowledge related to previous topics but will not focus specifically on previous topics. The final exam will be about one and one-half times as long as a mid-term exam, however you will have the full three hours in which to complete it.